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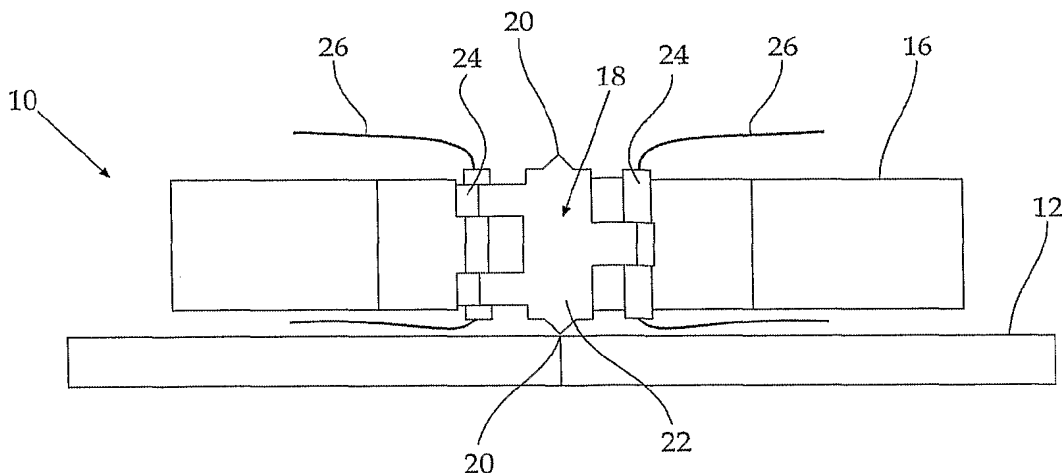
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(54) Title: SPINAL REAMER WITH CUTTER ELEMENTS ON TRACK



(57) Abstract: Spinal reamer apparatus (10) including a reference base (12) with mounting provisions (14) for mounting in a region of posterior lumbar spinal structure, a non-straight track (16) fixed to the reference base, and at least one reaming cutter element (18) arranged to move along the track. The mounting provisions may be holes positioned to correspond with pedicle screws or with mounting holes of a prosthesis. The reaming cutter element may comprise upper and lower cutting edges (20) at opposite ends of a cutter body (22). The apparatus is suited in particular for preparing the spine for disc replacement.

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## SPINAL REAMER WITH CUTTER ELEMENTS ON TRACK

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 USC §119 to U.S. Provisional Patent Application Serial No. 60/ 789,219, filed on April 5, 2006, which is incorporated herein by reference.

### FIELD OF THE INVENTION

The present invention relates to spinal reamers for use in surgical procedures, such as installing spinal prostheses.

### BACKGROUND OF THE INVENTION

Spinal disc or partial spinal disc replacement is a common procedure in Europe with thousands having been performed already and is now commencing in the United States. Examples of such replacement discs are ProDisc (Spine Solutions, Inc.) and SB Charite III (Link Spine Group, Inc.)

By replacing a disc and not merely fusing vertebrae, which is the common alternative practice to disc replacement, the mobility of the patient's adjacent discs may be preserved and thus may delay the onset of arthritic changes to adjacent vertebrae.

A typical disc replacement unit is approximately 30 millimeters in diameter. This relatively large cross-section usually necessitates a mostly anterior retroperitoneal (from the front of the abdomen but staying outside the intestinal sac) approach to the spine which may be risky. The risks of general anesthesia are coupled with risks of vascular injury and retrograde ejaculation in males.

Although many prosthetic disc devices are described in the literature, there is still a need for improvement in ease of manufacture and performance and of the preparation of the space for the insertion of the prosthesis.

### SUMMARY OF THE INVENTION

The present invention seeks to provide spinal reamers for use in surgical procedures, such as installing spinal prostheses, as is described more in detail hereinbelow. For example, following transforaminal posterior lumbar discectomy, a portion of the disc and endplate may remain behind. The spinal reamer apparatus may be used to ream, cut and/or remove material or debris.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Figs. 1A and 1B are simplified top-view and front-view illustrations, respectively, of spinal reamer apparatus, constructed and operative in accordance with an embodiment

of the present invention, including a single reaming cutter element arranged to move along a track;

Figs. 2A and 2B are simplified top-view and front-view illustrations, respectively, of spinal reamer apparatus, constructed and operative in accordance with another embodiment of the present invention, including a plurality of reaming cutter elements arranged to move along the track;

Fig. 3 is a simplified illustration of a set of reaming cutter elements useful in the spinal reamer apparatus of the invention;

Figs. 4A, 4B and 4C are simplified top-view, front-view and side-view illustrations, respectively, of spinal reamer apparatus, constructed and operative in accordance with another embodiment of the present invention, including a single reaming cutter element on a band saw blade;

Figs. 5A, 5B and 5C are simplified top-view, front-view and side-view illustrations, respectively, of spinal reamer apparatus, constructed and operative in accordance with another embodiment of the present invention, including a plurality of reaming cutter elements on the band saw blade;

Figs. 6A and 6B are simplified top-view and front-view illustrations, respectively, of spinal reamer apparatus, constructed and operative in accordance with another embodiment of the present invention, including a reaming cutter element with abrasive surfaces;

Figs. 7A and 7B are simplified top-view and front-sectional-view illustrations, respectively, of spinal reamer apparatus, constructed and operative in accordance with another embodiment of the present invention, including a spiral reaming cutter element; and

Figs. 8A and 8B are simplified top-view and front-view illustrations, respectively, of spinal reamer apparatus, constructed and operative in accordance with another embodiment of the present invention, including a rotating reaming cutter element.

#### DESCRIPTION OF EMBODIMENTS

Reference is now made to Figs. 1A and 1B, which illustrate spinal reamer apparatus 10, constructed and operative in accordance with a non-limiting embodiment of the present invention.

Spinal reamer apparatus 10 includes a reference base 12 with mounting provisions 14 for mounting in a region of posterior lumbar spinal structure. For example, mounting provisions 14 may be mounting holes positioned to correspond with the exact position of

mounting hardware (e.g., pedicle screws) or mounting holes of a spinal prosthesis (not shown) to be installed in the spine, e.g., posterior spinal structure or intravertebral or intervertebral space. For example, mounting provisions 14 may be mounting holes positioned to correspond with the exact position of holes drilled into bone for mounting pedicle screws of the implant described in US Patent 7,011,685, the disclosure of which is incorporated herein by reference.

A track 16 may be fixed to reference base 12. Track 16 in the non-limiting illustrated embodiment is non-straight, such as being arcuate. Track 16 may also shield spinal tissue from the reaming element.

A reaming cutter element 18 is arranged to move along track 16. The reaming cutter element 18 may be rigid or flexible. The reaming cutter element 18 may be fashioned from any combination of materials used for cutting spinal bone and tissues, such as but not limited to, ceramic, aluminum oxide, zirconium oxide, metal, metal alloy, cobalt-chromium-tungsten-nickel alloy, cobalt-chromium-manganese alloy, cobalt-chromium alloy, cobalt-chromium-molybdenum alloy, chromium-nickel-manganese alloy, powder metal alloy, 316L stainless steel, tool steel and many more. Reaming cutter element 18 may be used to ream, cut and/or remove disc material (e.g., annulus fibrosus, nucleus pulposus, cartilage and the like).

In the non-limiting illustrated embodiment, reaming cutter element 18 includes upper and lower cutting edges 20 at opposite ends of a cutter body 22. The cutter body 22 may include peripheral apertures 24, in which a cord 26 or other similar elongate member may be disposed for pulling (or pushing, depending on the stiffness of the cord 26) reaming cutter element 18 along track 16.

Reference is now made to Figs. 2A and 2B, which illustrate spinal reamer apparatus 10, constructed and operative in accordance with another embodiment of the present invention. In this version, spinal reamer apparatus 10 includes a plurality of reaming cutter elements 18 arranged to move along track 16. The plurality of reaming cutter elements 18 may act similar to a chain-saw.

Reference is now made to Fig. 3, which illustrates a set of reaming cutter elements 18 useful in the spinal reamer apparatus of the invention. It is noted that the reaming cutter elements are not necessarily identical, and may be provided in all sorts of sizes, shapes, cutting edges (e.g., straight, rounded, pointed, elongate, elliptic and many others), hardness, flexibility and other qualities and material properties.

Reference is now made to Figs. 4A, 4B and 4C, which illustrate spinal reamer apparatus 30, constructed and operative in accordance with another embodiment of the present invention. This embodiment is basically the same as that of Figs. 1A-1B, with like elements being designated by like reference numerals, except that spinal reamer apparatus 30 includes a reaming cutter element 32 on a band saw blade 34. The band saw blade 34 may be manipulated back and forth to move reaming cutter element 32 along track 16 and cut tissue. Reaming cutter element 32 may be constructed similarly to reaming cutter element 18.

Reference is now made to Figs. 5A, 5B and 5C, which illustrate spinal reamer apparatus 30, constructed and operative in accordance with another embodiment of the present invention. In this version, spinal reamer apparatus 30 includes a plurality of reaming cutter elements 32 on band saw blade 34.

Reference is now made to Figs. 6A and 6B, which illustrate spinal reamer apparatus 40, constructed and operative in accordance with another embodiment of the present invention. In this embodiment, spinal reamer apparatus 40 includes a reaming cutter element 42 with abrasive surfaces 44. For example, the abrasive surfaces 44 may be carborundum or other abrasive material coated or otherwise deposited on reaming cutter element 42. In accordance with a non-limiting embodiment of the invention, a vibrator 46 may be coupled to reaming cutter element 42. The vibrator 46 may be, without limitation, a motor that rotates an eccentric weight on a shaft or an oscillating weight, or an ultrasonic or piezoelectric vibrating device. Vibrator 46 sets up vibrations in reaming cutter element 42 and may improve or accelerate cutting of tissue. Vibrator 46 may be used with any of the embodiments of the invention.

Reference is now made to Figs. 7A and 7B, which illustrate spinal reamer apparatus 50, constructed and operative in accordance with another embodiment of the present invention. In this embodiment, spinal reamer apparatus 50 includes a spiral reaming cutter element 52, with cutting edges all along (or partially along) the spirals. Disc material may flow into the internal space of spiral reaming cutter element 52 during reaming.

Reference is now made to Figs. 8A and 8B, which illustrate spinal reamer apparatus 60, constructed and operative in accordance with another embodiment of the present invention. In this embodiment, spinal reamer apparatus 60 includes a rotating reaming cutter element 62. A rigid guide 64 may be inserted into the spinal space. A flexible shaft 66 may be connected to a reamer head 68, and inserted into the rigid guide

64. The flexible shaft 66 and the reamer head 68 may be rotated manually or electrically, such as by means of an operating handle 65, and advanced along guide 64. Reamer head 68 can be fashioned in any shape or size for different types of cleaning, removing or reaming.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations.

## CLAIMS

What is claimed is:

1. Spinal reamer apparatus comprising:
  - a reference base with mounting provisions for mounting in a region of posterior lumbar spinal structure;
  - a non-straight track fixed to said reference base; and
  - at least one reaming cutter element arranged to move along said track.
2. The spinal reamer apparatus according to claim 1, further comprising a plurality of reaming cutter elements arranged to move along said track, wherein at least one of the reaming cutter elements is not identical to another of the reaming cutter elements.
3. The spinal reamer apparatus according to claim 1, wherein said at least one reaming cutter element is rigid.
4. The spinal reamer apparatus according to claim 1, wherein said at least one reaming cutter element is flexible.
5. The spinal reamer apparatus according to claim 1, wherein said at least one reaming cutter element comprises upper and lower cutting edges at opposite ends of a cutter body.
6. The spinal reamer apparatus according to claim 1, wherein said at least one reaming cutter element is mounted on a band saw blade.
7. The spinal reamer apparatus according to claim 1, wherein said at least one reaming cutter element comprises abrasive cutting surfaces.
8. The spinal reamer apparatus according to claim 1, wherein said at least one reaming cutter element comprises a spiral cutting element.
9. The spinal reamer apparatus according to claim 1, wherein said at least one reaming cutter element comprises a rotatable cutting element.
10. The spinal reamer apparatus according to claim 1, further comprising a vibrator coupled to said at least one reaming cutter element.

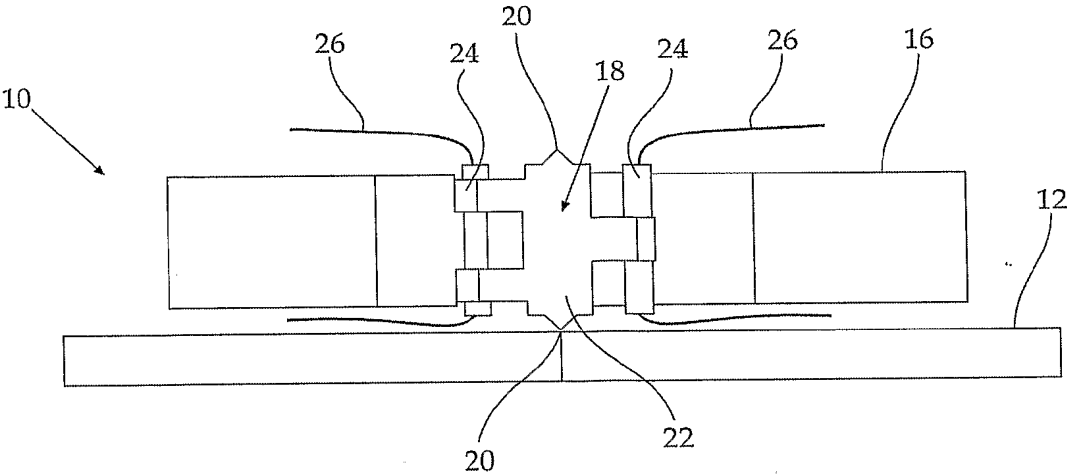


FIG. 1A

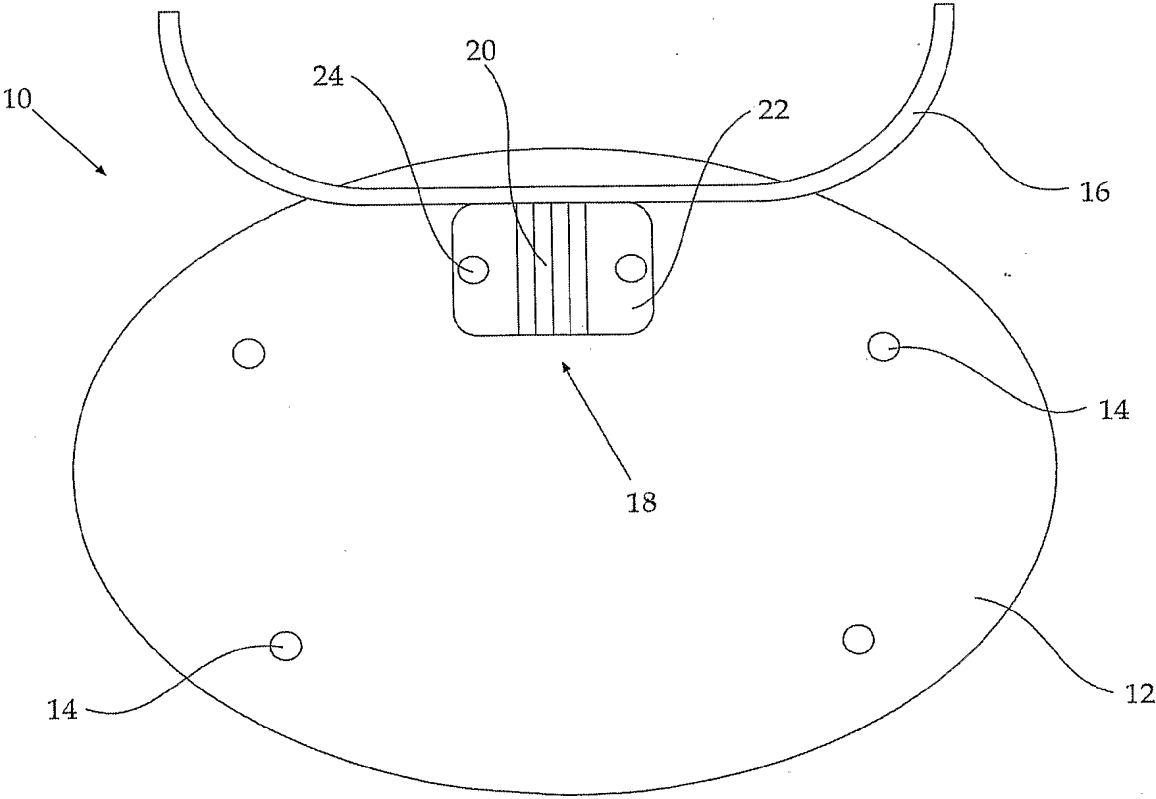


FIG. 1B



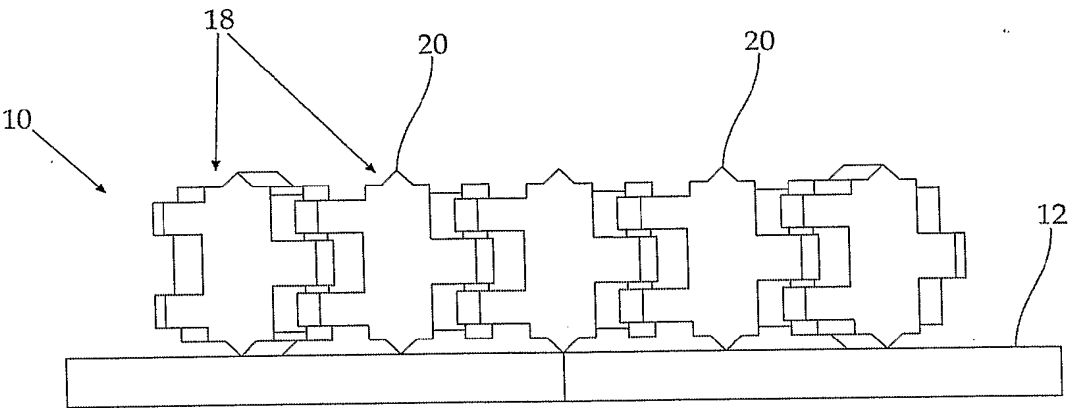


FIG. 2A

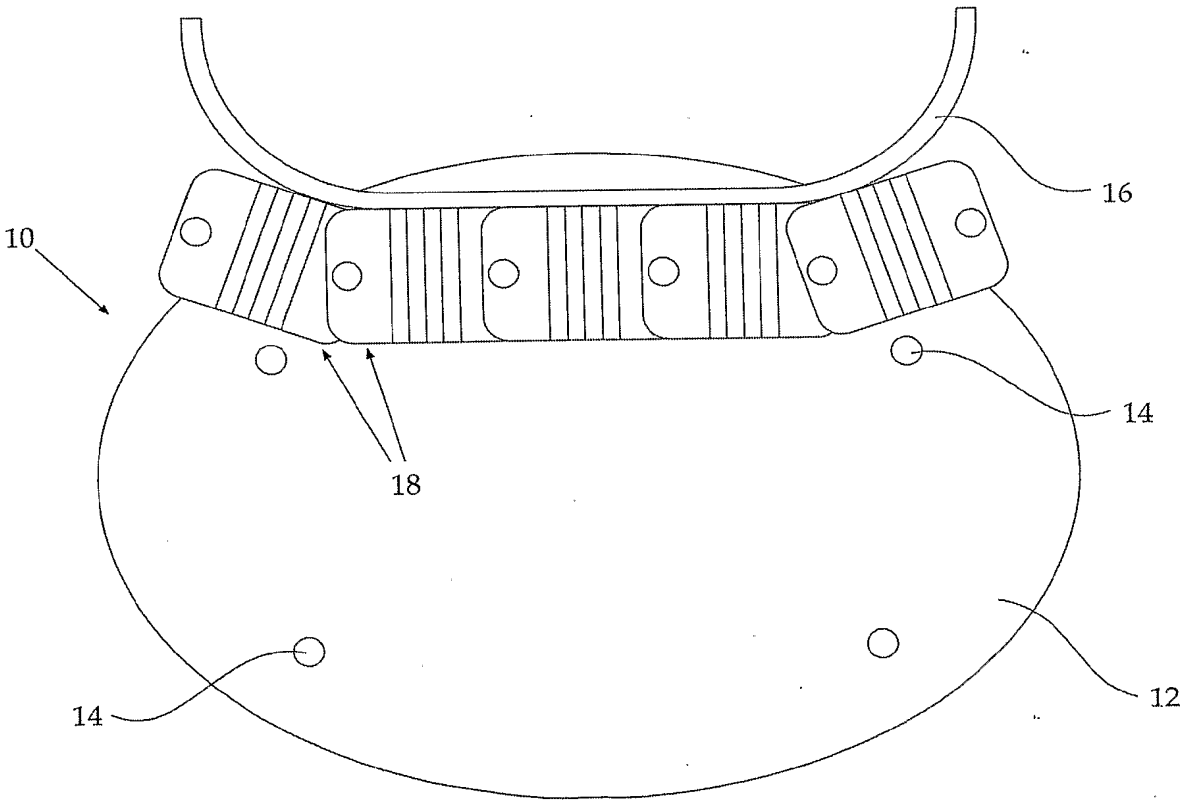
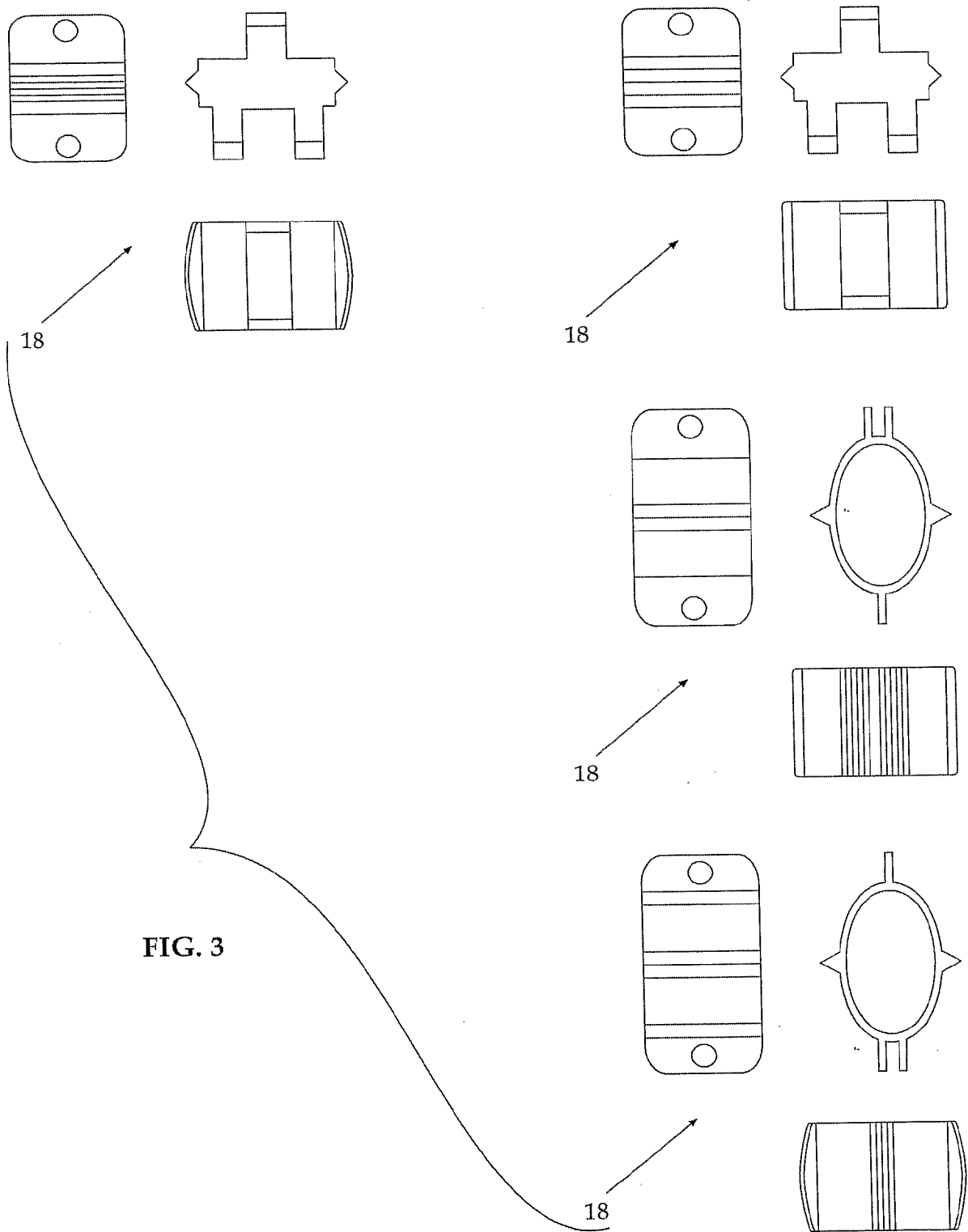


FIG. 2B



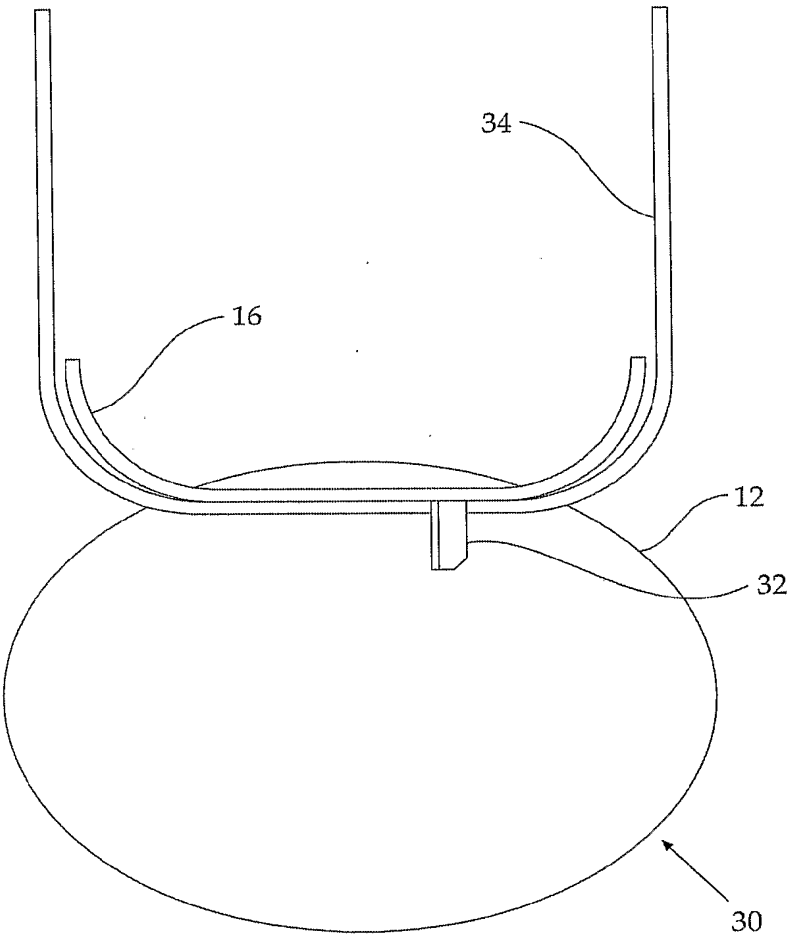


FIG. 4A

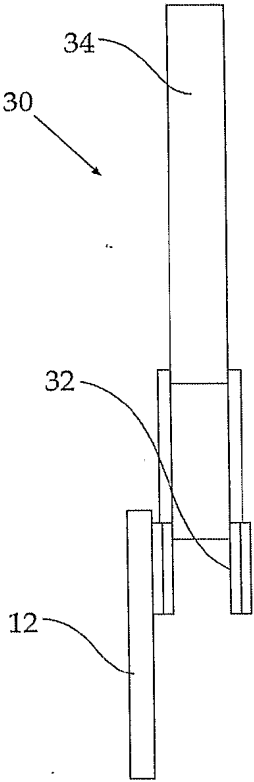


FIG. 4C

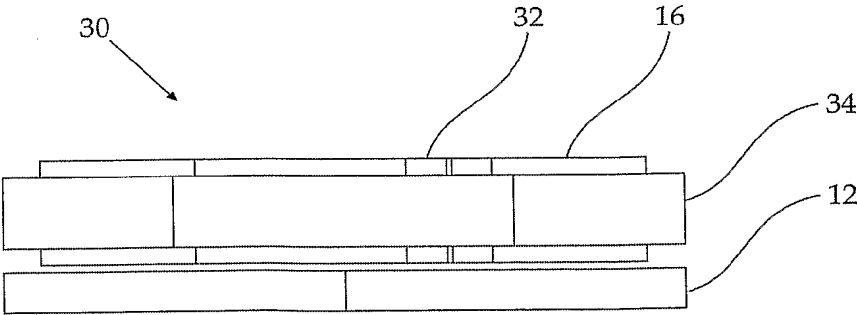


FIG. 4B

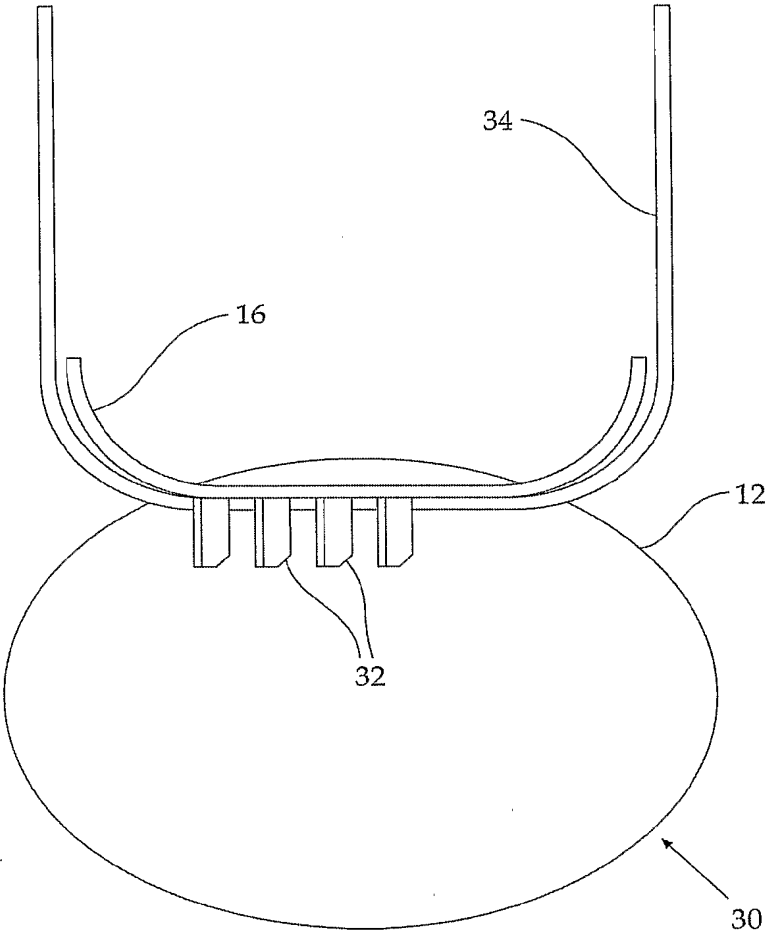


FIG. 5A

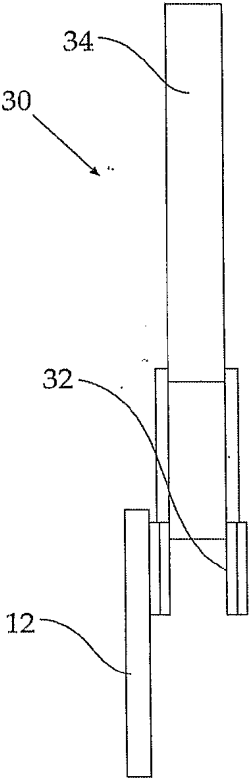


FIG. 5C

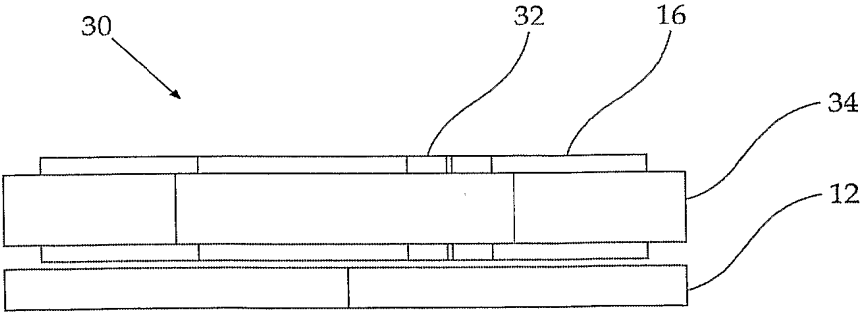


FIG. 5B

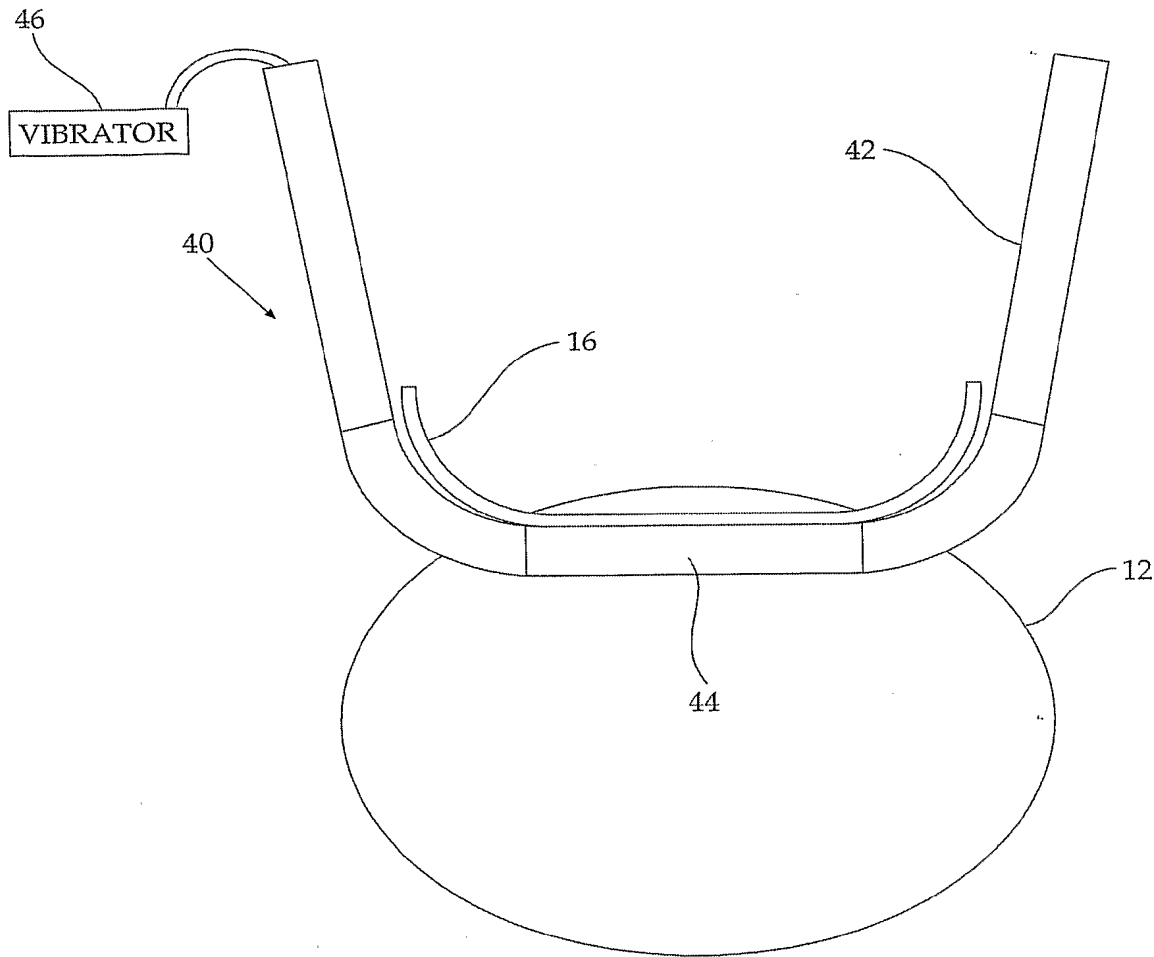


FIG. 6A

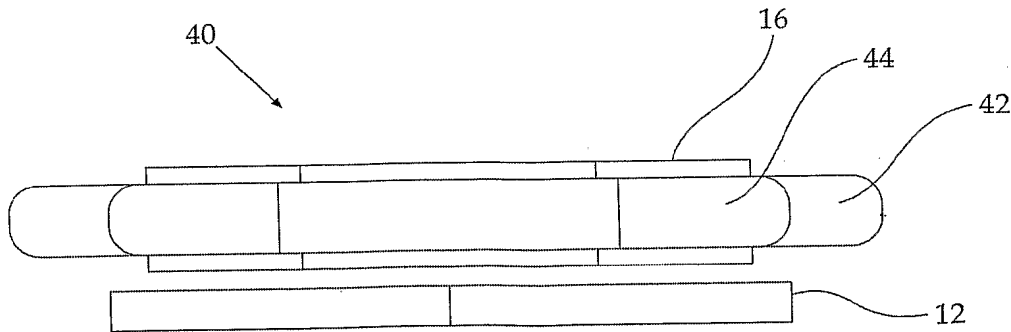


FIG. 6B

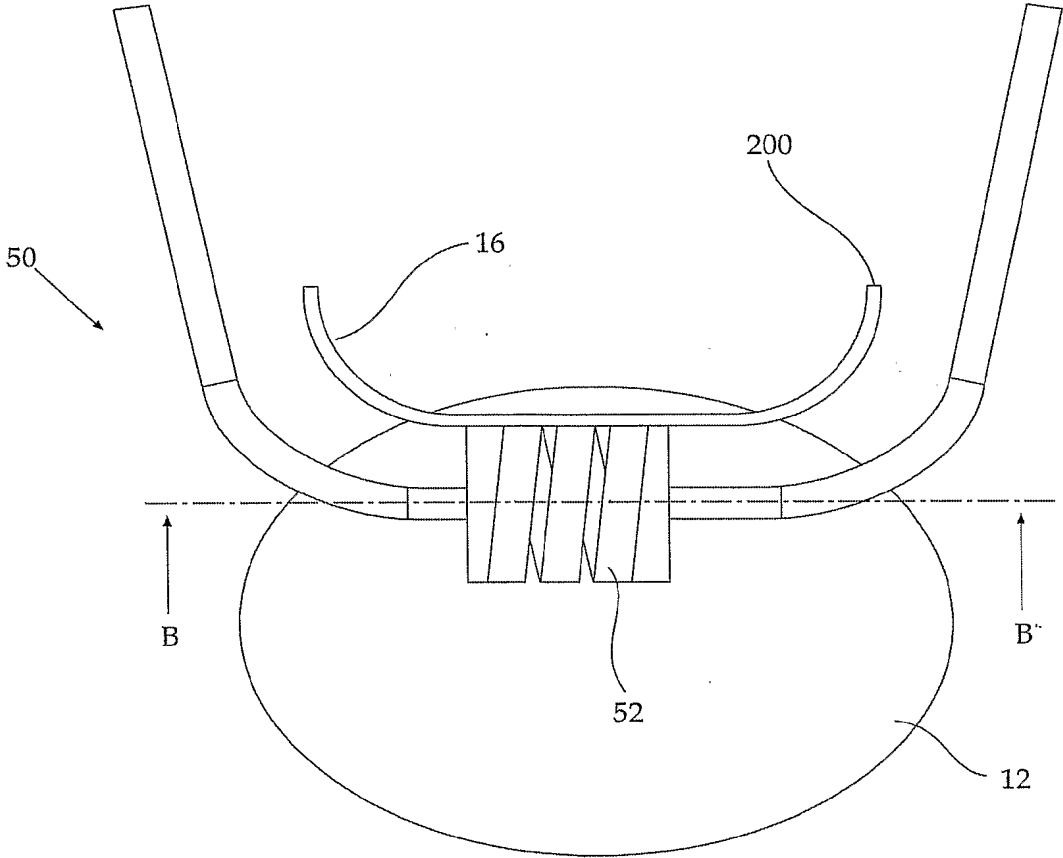


FIG. 7A

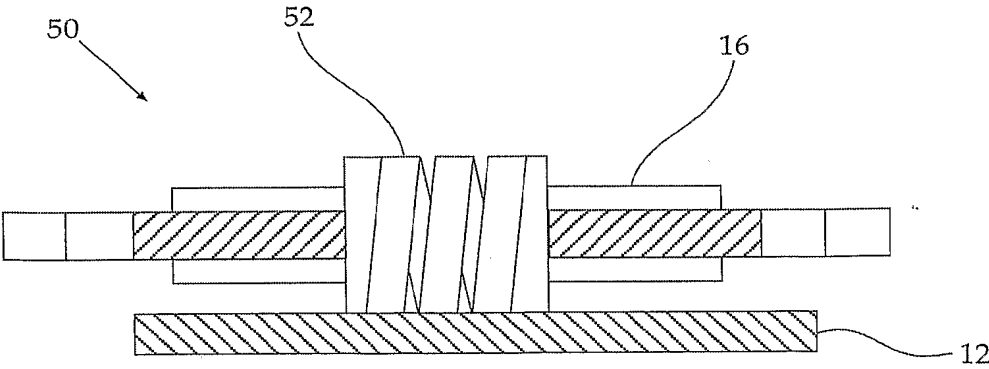


FIG. 7B

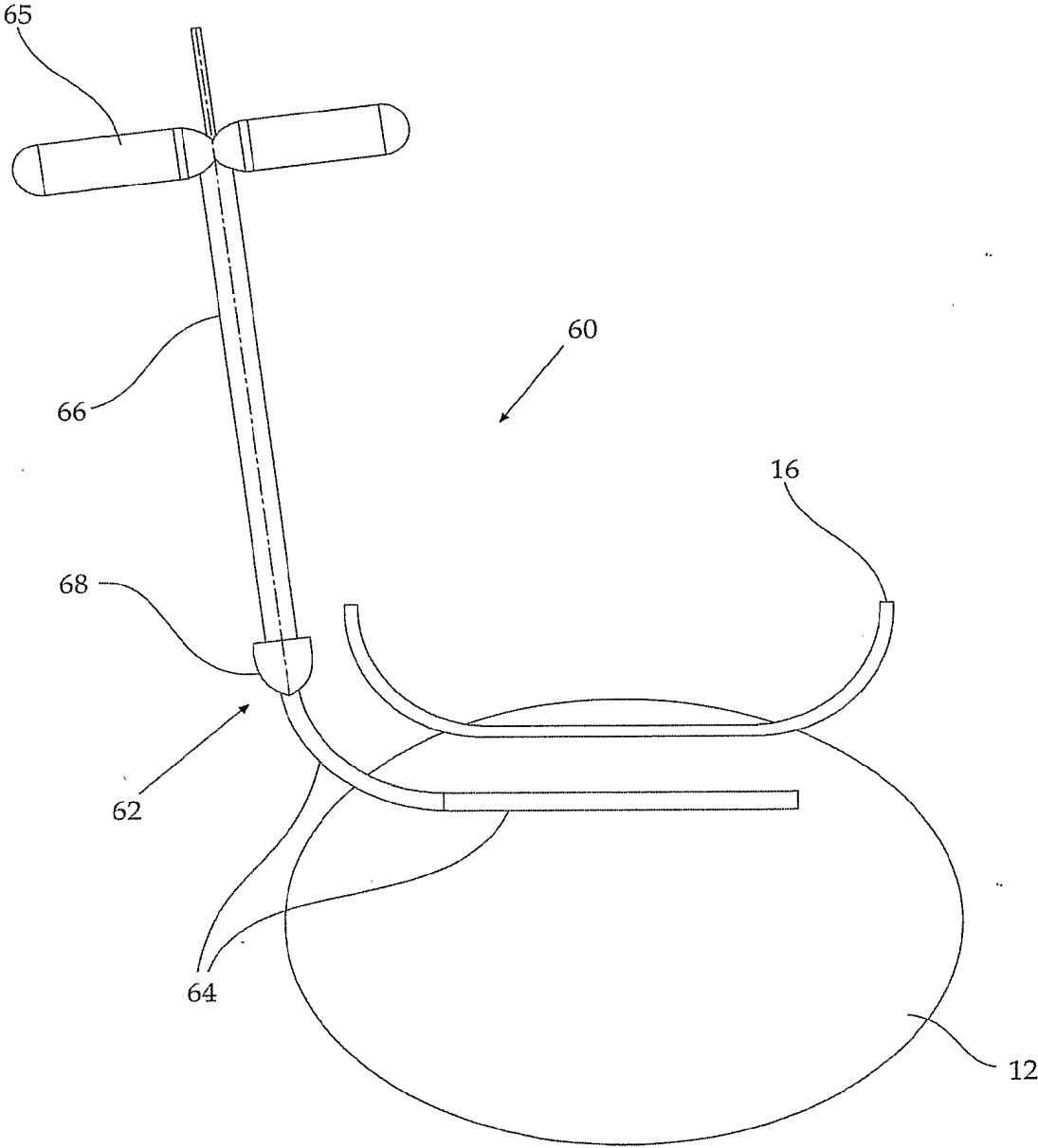


FIG. 8A

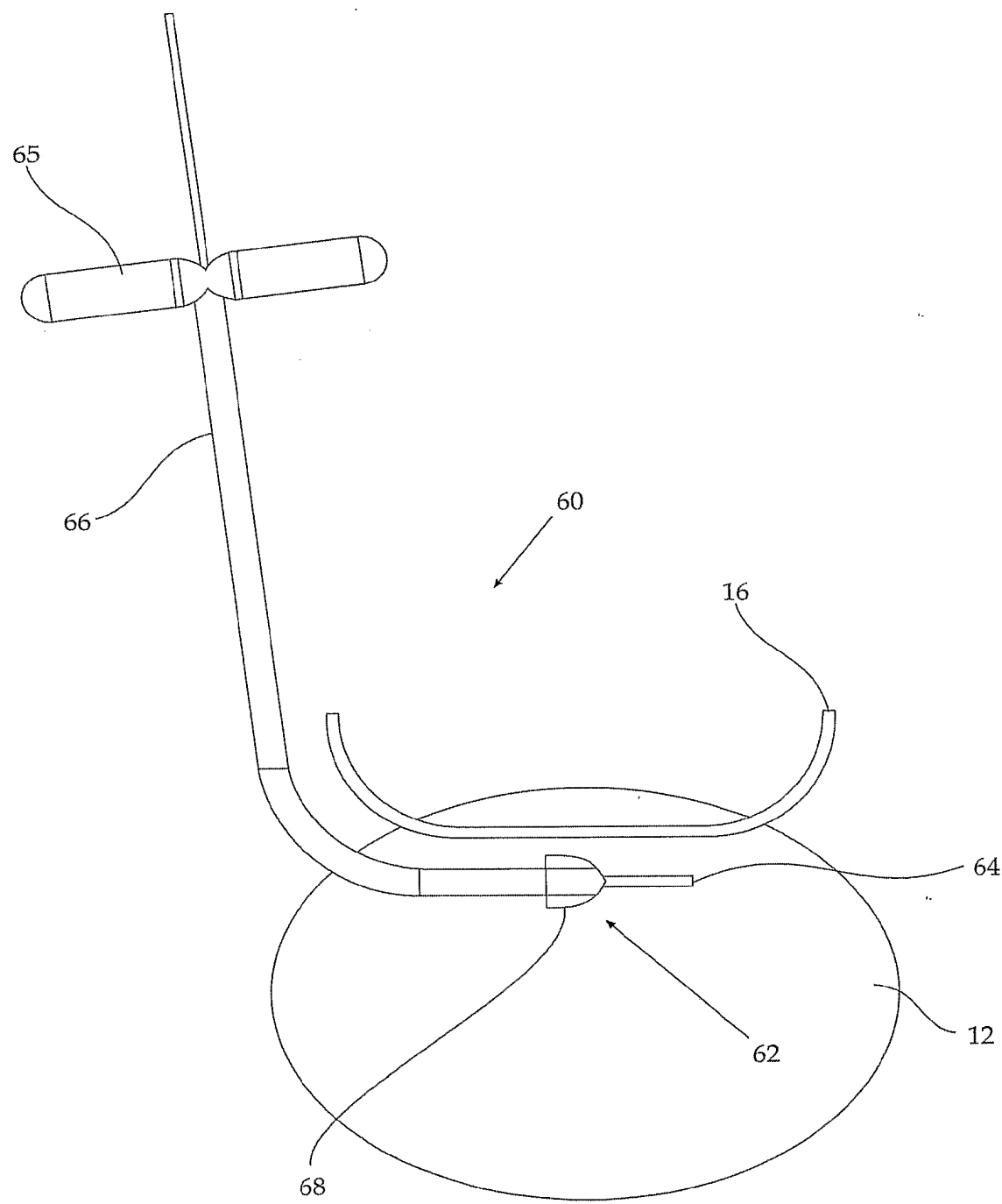


FIG. 8B



# INTERNATIONAL SEARCH REPORT

International application No

PCT/IL2007/000402

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. A61B17/14 A61B17/16

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 01/08571 A (DISC-O-TECH MEDICAL TECHNOLOGIES) 8 February 2001 (2001-02-08) page 7, line 27 - line 33 page 18, line 16 - page 19, line 3 page 22, line 27 - line 30 figures 2,8A-B	1
A	US 3 835 859 A (ROBERTS R.R. & DIGIOIA L.J.) 17 September 1974 (1974-09-17) the whole document	1
A	GB 1 571 926 A (HAMER G.) 23 July 1980 (1980-07-23) page 1, line 70 - line 76 claim 1; figure 1	1
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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## INTERNATIONAL SEARCH REPORT

International application No  
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005/273110 A1 (BOEHM F.H. & MELNICK B.D.) 8 December 2005 (2005-12-08) paragraph [0039]; figures 2,3 -----	1
A	US 2006/030854 A1 (HAINES T.G.) 9 February 2006 (2006-02-09) paragraph [0014]; figures 3,4 -----	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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